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GREEN LAKE, GREEN LAKE COUNTY, WISCONSIN

Pacific Northwest Environmental Research Laboratory

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June 1975

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U.S. ENVIRONMENTAL PROTECTION AGENCY
NATIONAL EUTROPHICATION SURVEY

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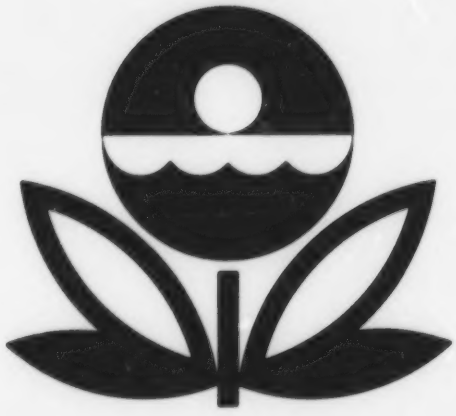

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16. ABSTRACT

Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivided according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

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ON
GREEN LAKE
GREEN LAKE COUNTY
WISCONSIN
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WORKING PAPER No. 39

WITH THE COOPERATION OF THE
WISCONSIN DEPARTMENT OF NATURAL RESOURCES
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FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to fresh water lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's fresh water lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGMENT

The staff of the National Eutrophication Survey (Office of Research & Development, U. S. Environmental Protection Agency) expresses sincere appreciation to the Wisconsin Department of Natural Resources for professional involvement and to the Wisconsin National Guard for conducting the tributary sampling phase of the Survey.

Francis H. Schraufnagel, Acting Assistant Director, and Joseph R. Ball of the Bureau of Water Quality, and Donald R. Winter, Lake Rehabilitation Program, provided invaluable lake documentation and counsel during the Survey. Central Office and District Office personnel of the Department of Natural Resources reviewed the preliminary reports and provided critiques most useful in the preparation of this Working Paper series.

Major General James J. Lison, Jr., the Adjutant General of Wisconsin, and Project Officer CW-4 Donald D. Erickson, who directed the volunteer efforts of the Wisconsin National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

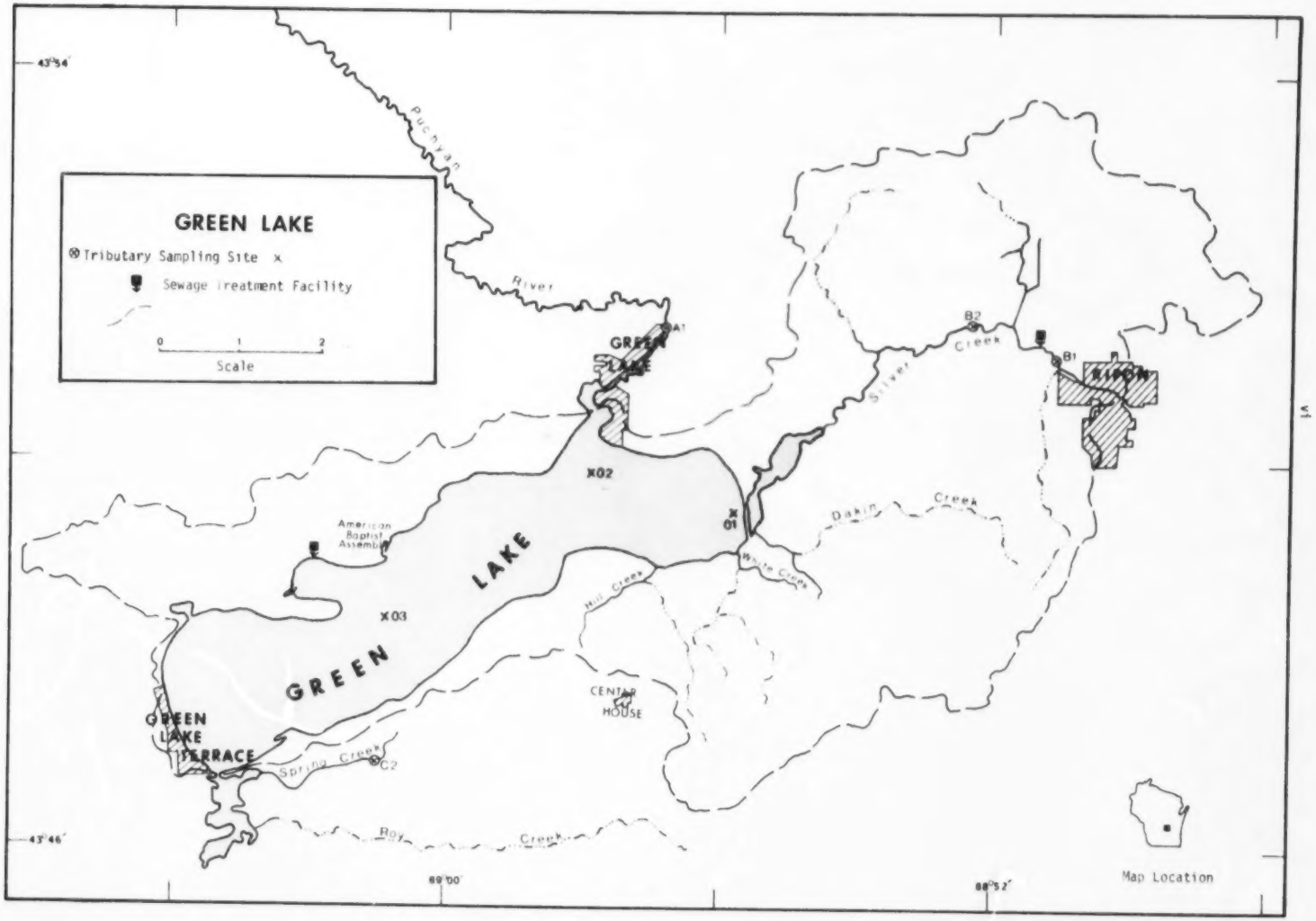
NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF WISCONSIN

LAKE NAME	COUNTY
Altoona	Eau Claire
Beaver Dam	Barron
Beaver Dam	Dodge
Big Eau Pleine	Marathon
Browns	Racine
Butte des Morts	Winnebago
Butternut	Price, Ashland
Castle Rock Flowage	Juneau
Como	Walworth
Crystal	Vilas
Delavan	Walworth
Eau Claire	Eau Claire
Geneva	Walworth
Grand	Green Lake
Green	Green Lake
Kegonsa	Dane
Koshkonong	Jefferson, Rock, Dane
Lac La Belle	Waukesha
Middle	Walworth
Nagawicka	Waukesha
Oconomowoc	Waukesha
Okauchee	Waukesha
Petenwell Flowage	Juneau
Pewaukee	Waukesha
Pigeon	Waupaca
Pine	Waukesha
Poygan	Winnebago, Waushara
Rock	Jefferson
Rome Pond	Jefferson, Waukesha
Round	Waupaca
Shawano	Shawano
Sinnissippi	Dodge

LAKE NAME	COUNTY
Swan	Columbia
Tainter	Dunn
Tichigan	Racine
Townline	Oneida
Trout	Vilas
Wapogassett	Polk
Wausau	Marathon
Willow	Oneida
Winnebago	Winnebago, Fond Du Lac, Calumet
Wisconsin	Columbia
Wissota	Chippewa
Yellow	Burnett


GREEN LAKE
Tributary Sampling Site x
Sewage Treatment Facility
0 1 2
Scale
43°54'
43°46'
89°00'
88°52'
Fox River
GREEN LAKE
B2
Silver Creek
B1
KIEKON
X02
X01
American Baptist Assembly
Dakin Creek
Marsh Creek
Hill Creek
X03
GREEN LAKE
CENTER HOUSE
GREEN LAKE TERRACE
Spring Creek
C2
Bay Creek
Map Location

GREEN LAKE

STORET NO. 5519

I. CONCLUSIONS

A. Trophic Condition:

At this time, Green Lake is mesotrophic and still exhibits some of the desirable trophic characteristics observed by Birge and Juday (1914) in the very early 1900's. However, it appears that only the large hypolimnetic volume of the lake has prevented marked trophic responses to culturally-induced nutrient inputs to the lake.

B. Rate-Limiting Nutrient:

A loss of both phosphorus and nitrogen occurred in the algal assay sample between the time of collection and the beginning of the assay, and the results are not representative of conditions in the lake at the time the sample was taken (11/08/72).

The lake data for the photic zone (assumed to be from the surface to 20 feet deep) indicate nitrogen limitation at all sampling times.

C. Nutrient Controllability:

1. Point sources--During the sampling year, Green Lake received a total phosphorus load at a rate just in excess of

that proposed by Vollenweider (in press) as "dangerous"; i.e., a eutrophic rate (see page 17). It is calculated that the City of Ripon and the American Baptist Assembly contributed 45% of that load.

As a result of orders issued by the Wisconsin Department of Natural Resources, the American Baptist Assembly wastewater treatment plant effluent was diverted to an evaporation-seepage pond on March 9, 1973, and chemical phosphorus removal was begun at the City of Ripon wastewater treatment plant on February 28, 1973 (at the time of preparation of this report, construction of expanded treatment facilities at Ripon was underway).

The improvements noted above resulted in the elimination of phosphorus from one point source and a reduction in the phosphorus input from the other point source for six months of the Survey sampling year. On a full-year basis, it is calculated that the point-source phosphorus load will be reduced from the 7,390-pound input during the Survey sampling year to about 3,700 pounds per year (assuming no input by the American Baptist Assembly and an expected 85% removal of the estimated 3.5 pounds P/capita/year at Ripon).

The reduced phosphorus input will result in a loading rate of 0.19 $g/m^2/yr$--a mesotrophic loading rate. The lower loading

rate should eventually result in persistent phosphorus limitation and enhancement of the trophic condition of Green Lake. However, since the lake has a mean hydraulic retention time of 21 years, it cannot be expected that changes in the trophic condition of the lake will be rapid and/or readily obvious.

2. Non-point sources (see page 17)--Although the Silver Creek phosphorus export rate was more than 2½ times that of Spring Creek during the sampling year, the difference probably is due to the much greater drainage area of Silver Creek since there were no known point sources impacting the stream at the point of sampling (station B-1).

In all, it is estimated that non-point sources, excluding precipitation, contributed about 45% of the total phosphorus load to Green Lake during the sampling year.

II. INTRODUCTION

Green Lake is the deepest lake within Wisconsin (Fassbender and Weber, 1971), and was described as "... an unusally attractive body of water ..." by Birge and Juday (op. cit.) in the early 1900's. The lake is still scenically attractive; however, residences now occupy 90-95% of the shoreline and adjacent areas.

Public access is available at some ten sites around the lake, and a boat livery is located near the town of Green Lake. Recreational uses of the lake include boating, swimming, and fishing.

Fishing is reported to be good to excellent, both summer and winter. Cold-water species of fish include brown, rainbow, and lake trout, and deep-dwellings ciscoes; warm-water species include northern pike, walleyes, large- and smallmouth bass, and panfish.

A five-foot-head dam in the outlet (in place pre-1914) generally maintains the lake level above the natural level.

III. LAKE AND DRAINAGE BASIN CHARACTERISTICS

A. Lake Morphometry†:

1. Surface area: 7,346 acres.
2. Mean depth: 103.6 feet.
3. Maximum depth: 236 feet.
4. Volume: 761,277 acre-feet.
5. Mean hydraulic retention time: 21 years.

B. Tributary and Outlet:
(See Appendix A for flow data)

1. Tributaries -

Name	Drainage area (mi^2)	Mean flow (cfs)
Silver Creek	36.0	14.3
Spring Creek	1.9	0.5
Minor tributaries & immediate drainage -	67.6	35.5
Totals	105.5	50.3

2. Outlet -

Puchyan River	117.0**	50.3**

C. Precipitation***:

1. Year of sampling: 41.5 inches.
2. Mean annual: 30.0 inches.

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† Wisconsin Dept. of Natural Resources 1969 lake survey map.
* Drainage areas are accurate within ±0.5%; mean daily flows are accurate within ±40%; mean monthly flows are accurate within ±35%; and normalized monthly flows are accurate within ±35%.
** Includes area of lake; outflow adjusted to equal sum of inflows.
*** See Working Paper No. 1, "Survey Methods, 1972".

IV. LAKE WATER QUALITY SUMMARY

Green Lake was sampled three times during the open-water season of 1972 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from three stations on the lake and from a number of depths at each station (see map, page vi). During each visit, a single depth-integrated (15 feet or near bottom to surface) sample was composited from the stations for phytoplankton identification and enumeration; and during the last visit (during fall overturn), a single five-gallon depth-integrated sample was composited from the three stations for algal assays. Also each time, a depth-integrated sample was collected from each of the stations for chlorophyll a analysis. The maximum depths sampled were 26 feet at station 1, 23 feet at station 2, and 205 feet at station 3.

The results obtained are presented in full in Appendix B, and the data for the fall sampling period, when the lake essentially was well-mixed, are summarized below. Note, however, the Secchi disc summary is based on all values.

For differences in the various parameters at the other sampling times, refer to Appendix B.

A. Physical and chemical characteristics:

Parameter	Minimum	Mean	Median	Maximum
		FALL VALUES (11/08/72)		
Temperature (Cent.)	4.7	7.0	7.6	7.8
Dissolved oxygen (mg/l)	6.4	9.9	10.8	11.2
Conductivity (μmhos)	400	412	410	420
pH (units)	7.6	8.2	8.3	8.4
Alkalinity (mg/l)	168	180	180	190
Total P (mg/l)	0.025	0.042	0.028	0.109
Dissolved P (mg/l)	0.020	0.038	0.024	0.109
NO_2 + NO_3 (mg/l)	0.150	0.214	0.195	0.370
Ammonia (mg/l)	0.030	0.041	0.040	0.050
		ALL VALUES		
Secchi disc (inches)	166	227	225	300

B. Biological characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Number per ml
06/22/72	1. Dinobryon	1,160
	2. Fragilaria	640
	3. Schroederia	384
	4. Gleocapsa	226
	5. Chroococcus	106
	Other genera	393
	Total	2,909
08/21/72	1. Dinobryon	1,628
	2. Anabaena	1,284
	3. Microcystis	796
	4. Flagellates	398
	5. Chroococcus	362
	Other genera	523
	Total	4,991
11/08/72	1. Dinobryon	524
	2. Cyclotella	443
	3. Asterionella	407
	4. Synedra	172
	5. Microcystis	154
	Other genera	452
	Total	2,152

2. Chlorophyll a -
(Because of instrumentation problems during the 1972 sampling, the following values may be in error by plus or minus 20 percent.)

Sampling Date	Station Number	Chlorophyll a (µg/l)
06/22/72	01	1.8
	02	-
	03	2.0
08/21/72	01	0.9
	02	0.7
	03	0.9
11/08/72	01	9.6
	02	6.8
	03	7.4

C. Limiting Nutrient Study:

There was a loss of 38% of the dissolved phosphorus and 17% of the inorganic nitrogen in the assay sample between the time of collection and the beginning of the assay (based on analysis of lake samples at the time the assay sample was collected and the analysis of the assay sample at the beginning of the test). Therefore, the results are not indicative of conditions in the lake at the time the sample was collected. However, the lake data for the photic zone (assumed to be from the surface to 20 feet deep) indicate nitrogen limitation at all sampling times; i.e., the mean N/P ratios were 10/1 or less, and nitrogen limitation would be expected.

D. Trophic Condition of Green Lake:

A casual examination of the Green Lake nutrient data obtained during the Survey (see summary on page 7 and Appendix B) might lead to the conclusion that the lake is eutrophic. The relatively high mean dissolved phosphorus of 0.036 mg/l, for example, was exceeded in only 22 of the 46 Wisconsin lakes surveyed in 1972. Also, the early season blooms of green algae, reported by others (Stauffer, 1973) but not observed by personnel of this Survey, would strengthen that conclusion.

However, any assessment of the trophic condition of Green Lake must take into account the very great depth of the lake and the large volume of the hypolimnion when the lake is stratified. The thermocline in Green Lake commonly begins at a depth of about 30+ feet and extends to a depth of about 65 feet; with the thermocline at this level, the hypolimnion constitutes almost 56% of the entire volume of the lake.

The influence of this vast hypolimnion on mean values obtained can be readily seen in the August data for station 3 (Appendix B). It will be noted that while the epilimnion and the thermocline contained only 0.009 mg/l of dissolved

phosphorus, there was sharp increase in the 60-foot and deeper samples to a level of 0.200 mg/l at 205 feet. It will be seen that a similar situation is evident in the November data obtained during the fall overturn. The higher concentrations of phosphorus at depth are due to the "rain" of organic matter from the photic zone (epilimnion and upper thermocline) during the growing season with an eventual deposition of much of these materials in the bottom sediments and an impoverishment of phosphorus in the photic zone.

It is believed that much of the sedimented phosphorus is not recycled because reducing conditions apparently rarely occur in the waters adjacent to the sediments even at great depths. Historical (Birge and Juday, 1911) and recent data provided by the Wisconsin Department of Natural Resources (Winter, 1973) show that in none of the samples collected at depths greater than 200 feet on 22 occasions during varying seasons and conditions was dissolved oxygen completely absent, and in only three samples was dissolved oxygen less than 1 mg/l. It is probable that nutrient entrappment in the bottom sediments is the reason Green Lake has not shown the nuisance conditions and trophic responses

one would expect in a lake that previously received an annual phosphorus loading rate well in excess of that considered by Vollenweider (in press) as "dangerous"; i.e., a eutrophic rate (see page 17).

Except for mean phosphorus, all of the parameters measured during the Survey indicate that Green Lake is mesotrophic. The occurrence of dissolved oxygen at great depths, transparency appreciably bettered only by that of oligotrophic Crystal Lake (Wisconsin), and the low mean chlorophyll a are indicative of a mesotrophic condition. Also, the lack of truly objectionable nuisance conditions is indicated by the absence of any chemical control efforts at this highly-developed and heavily-used lake since the 1950 and 1952 seasons (Lueschow, 1972).

V. NUTRIENT LOADINGS
(See Appendix C for data)

For the determination of nutrient loadings, the Wisconsin National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page vi), except for the high runoff months of April and May when two samples were collected. Sampling was begun in September, 1972, and was completed in August, 1973.

Through an interagency agreement, stream flows estimates for the year of sampling and a "normalized" or average year were provided by the Wisconsin District Office of the U.S. Geological Survey for the tributary sites nearest the lake.

In this report, nutrient loads for sampled tributaries were calculated using mean concentrations and mean flows. Nutrient loadings for unsampled "minor tributaries and immediate drainage" ("ZZ" of U.S.G.S.) were estimated by using the mean concentrations in Spring Creek at station C-2 and the mean ZZ flow.

The operator of the American Baptist Assembly STP provided monthly composite effluent samples and daily and mean monthly flow data; in the following tables, the nutrient loads attributed to this source are one-half the measured loads since the treatment plant discharged to Green Lake only six months of the Survey sampling year.

The City of Ripon did not participate in the Survey, and nutrient loads were determined by the differences in nutrient loads in Silver Creek at station B-1, just above the Ripon STP, and at station B-2 about 1½ miles below. The Ripon STP flows were estimated on the basis of information supplied by the Wisconsin Department of Natural Resources (Schraufnagel, 1973); "population served" is the 1970 Census population.

Nutrient loads given for Silver Creek are those measured at station B-1 above the Ripon STP.

A. Waste Sources:

1. Known municipal -

Name	Pop. Served	Treatment	Mean Flow (mgd)	Receiving Water
Ripon	7,053	trickling filter + P removal	1.015	Silver Creek
American Baptist Assembly	136* (500)*	trickling filter + evapo-seepage pond	0.036	(Green Lake)

2. Industrial -

Name	Product	Treatment	Mean Flow (mgd)	Receiving Water
Green Giant Foods, Ripon	Canned vege-tables	spray irrigation (no discharge)	unknown	(Silver Creek)

* Estimated mean annual population; population in parenthesis is estimated maximum summer population.

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	lbs P/ yr	% of total
a. Tributaries (non-point load) -		
Silver Creek	3,050	18.6
Spring Creek	60	0.4
b. Minor tributaries & immediate drainage (non-point load) -	4,260	26.0
c. Known municipal -		
Ripon	7,140	43.6
American Baptist Assembly	250	1.5
d. Septic tanks* -	460	2.8
e. Known industrial -		
Green Giant Foods	none	-
f. Direct precipitation** -	1,150	7.1
Total	16,370	100.0

2. Outputs -

Lake outlet - Puchyan River 8,910

3. Net annual P accumulation - 7,460 pounds

* Estimate based on 622 lakeshore dwellings and 11 resorts (Fassbender and Weber, 1971); see Working Paper No. 1.
** See Working Paper No. 1.

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	lbs N/ yr	% of total
a. Tributaries (non-point load) -		
Silver Creek	105,230	28.0
Spring Creek	2,020	0.5
b. Minor tributaries & immediate drainage (non-point load) -	143,760	38.2
c. Known municipal -		
Ripon	36,930	9.8
American Baptist Assembly	510	0.1
d. Septic tanks* -	17,200	4.6
e. Known industrial -		
Green Giant Foods	none	-
f. Direct precipitation** -	70,770	18.8
Total	376,420	100.0

2. Outputs -

Lake outlet - Puchyan River 105,360

3. Net annual N accumulation - 271,060 pounds

* Estimate based on 622 lakeshore dwellings and 11 resorts (Fassbender and Weber, 1971); see Working Paper No. 1.
** See Working Paper No. 1.

D. Mean Annual Non-point Nutrient Export by Subdrainage Area:

Tributary	lbs P/mi^2/yr	lbs N/mi^2/yr
Silver Creek	85	2,923
Spring Creek	32	1,063

E. Yearly Loading Rates:

In the following table, the existing phosphorus loading rates are compared to those proposed by Vollenweider (in press). Essentially, his "dangerous" rate is the rate at which the receiving waters would become eutrophic or remain eutrophic; his "permissible" rate is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A mesotrophic rate would be considered one between "dangerous" and "permissible".

	Total Phosphorus		Total Nitrogen	
	Total	Accumulated	Total	Accumulated
lbs/acre/yr	2.2	1.0	51.2	36.9
grams/m^2/yr	0.25	0.11	5.7	4.1

Vollenweider loading rates for phosphorus (g/m^2/yr) based on mean depth and mean hydraulic retention time of Green Lake:

"Dangerous" (eutrophic rate)	0.24
"Permissible" (oligotrophic rate)	0.12

D. Mean Annual Non-point Nutrient Export by Subdrainage Area:

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VII. APPENDICES

APPENDIX A

TRIBUTARY FLOW DATA

TRIBUTARY FLOW INFORMATION FOR WISCONSIN 6/18/75

LAKE CODE 5519 GREEN LAKE

TOTAL DRAINAGE AREA OF LAKE(SQ MI) 117.00

TRIBUTARY	SUB-DRAINAGE AREA(SQ MI)	NORMALIZED FLOWS(CFS) JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
5519A1	117.00	21.00	24.00	109.00	118.10	70.80	70.80	35.40	27.20	30.00	30.90	41.80	24.80	50.48
5519B2	36.00	5.40	6.00	30.20	33.00	20.00	22.00	9.50	6.60	7.20	7.40	11.00	4.70	14.25
5519C2	1.94	0.10	0.10	1.70	1.90	0.71	1.00	0.30	0.20	0.20	0.20	0.30	0.10	0.53
5519Z2	79.10	15.00	17.00	81.00	94.00	50.00	52.00	25.00	18.00	20.00	20.00	29.00	14.00	35.45

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 117.00
SUM OF SUB-DRAINAGE AREAS = 117.04

TOTAL FLOW IN = 602.10
TOTAL FLOW OUT = 605.10

MEAN MONTHLY FLOWS AND DAILY FLOWS(CFS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
5519A1	9	72	120.00	24	130.00				
	10	72	150.00	22	140.00				
	11	72	140.00						
	12	72	85.00	23	80.00				
	1	73	190.00						
	2	73	150.00	4	250.00				
	3	73	400.00	3	270.00				
	4	73	260.00	1	220.00	15	280.00		
	5	73	310.00	6	310.00	15	270.00		
	6	73	150.00	16	150.00				
	7	73	58.00	6	74.00				
	8	73	36.00	4	50.00				
5519B2	9	72	33.00	24	36.00				
	10	72	42.00	22	40.00				
	11	72	38.00						
	12	72	22.00	23	23.00				
	1	73	58.00						
	2	73	45.00	4	77.00				
	3	73	130.00	3	88.00				
	4	73	80.00	1	89.00	15	80.00		
	5	73	94.00	6	94.00	15	82.00		
	6	73	41.00	16	42.00				
	7	73	18.00	6	19.00				
	8	73	16.00	4	15.00				

TRIBUTARY FLOW INFORMATION FOR WISCONSIN 6/18/75

LAKE CODE 5519 [illegible] LAKE

MEAN MONTHLY FLOWS AND DAILY FLOWS(CFS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
5519C2	9	72	1.4[illegible]	24	1.50				
	10	72	1.8[illegible]	22	1.60				
	11	72	1.5[illegible]						
	12	72	1.[illegible]0	23	6.90				
	1	73	5.[illegible]0						
	2	73	2.5[illegible]	4	4.20				
	3	73	5.1[illegible]	3	5.40				
	4	73	4.3[illegible]	1	3.60	15	4.30		
	5	73	4.9[illegible]	6	4.90	15	4.40		
	6	73	1.5[illegible]	16	1.60				
	7	73	0.7[illegible]	8	0.80				
	8	73	0.70	4	0.70				
551922	9	72	79.[illegible]0	24	89.00				
	10	72	130.[illegible]0	22	95.00				
	11	72	89.[illegible]0						
	12	72	56.00	23	54.00				
	1	73	140.[illegible]0						
	2	73	99.[illegible]0	4	170.00				
	3	73	280.[illegible]0	3	190.00				
	4	73	180.00	1	150.00	15	180.00		
	5	73	210.[illegible]0	6	210.00	15	180.00		
	6	73	100.[illegible]0	16	100.00				
	7	73	42.[illegible]0	8	44.00				
	8	73	37.[illegible]0	4	34.00				

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APPENDIX B

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 75/06/16

551901
43 49 30.0 088 56 00.0
GREEN LAKE
55 WISCONSIN

11EPALES
5

2111202
0018 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3-N TOTAL MG/L	00665 PHOS-TOT MG/L P	00666 PHOS-DIS MG/L P
72/06/22	16 00	0000	16.8	11.2	214	350	8.70	185	0.060	0.070	0.052	0.019
	16 00	0010	15.8	9.3		340	8.60	180	0.050	0.050	0.018	0.015
72/08/21	08 20	0000			216	380	8.50	171	0.040	0.040	0.012	0.009
	08 20	0004	24.0	8.9		370	8.50	174	0.030	0.030	0.011	0.008
	08 20	0015	24.0	8.6		380	8.50	174	0.030	0.040	0.012	0.007
	08 20	0020	23.9	8.6		365	8.50	164	0.040	0.060	0.011	0.008
	08 20	0026	23.6	9.6		380	8.41	166	0.040	0.060	0.013	0.008
72/11/08	14 00	0000			166	420	8.40	184	0.210	0.040	0.027	0.022
	14 00	0004	7.6	11.0		420	8.40	184	0.210	0.040	0.028	0.023
	14 00	0015	7.7	11.2		410	8.40	181	0.210	0.050	0.029	0.024
	14 00	0024	7.6	11.0		410	8.40	184	0.200	0.040	0.031	0.024

DATE FROM TO	TIME OF DAY	DEPTH FEET	32217 CHLRPHYL A UG/L
72/06/22	16 00	0000	1.8J
72/08/21	08 20	0000	0.9J
72/11/08	14 00	0000	9.6J

J VALUE ESTIMATED OR NOT ACCEPTABLE

STORET RETRIEVAL DATE 75/06/16

551902
43 50 00.0 088 58 00.0
GREEN LAKE
55 WISCONSIN

11EPALES
5

2111202
0020 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3-N TOTAL MG/L	00665 PHOS-TOT MG/L P	00666 PHOS-DIS MG/L P
72/06/22	16 25	0000	17.8	10.8	234	345	8.70	185	0.060	0.090	0.019	0.014
	16 25	0015	10.6	12.5		320	8.50	178	0.120	0.050	0.028	0.016
72/08/21	08 40	0000			216	373	8.50	168	0.030	0.040	0.011	0.008
	08 40	0004	24.2	8.8		360	8.50	170	0.030	0.030	0.011	0.007
	08 40	0015	24.1	9.3		380	8.50	169	0.030	0.030	0.011	0.007
	08 40	0023	23.3	11.4		365	8.50	172	0.030	0.040	0.012	0.007
72/11/08	15 15	0000			240	410	8.30	179	0.160	0.050	0.026	0.022
	15 15	0004	7.7	10.7		405	8.30	177	0.160	0.040	0.027	0.023
	15 15	0018	7.7	11.0		400	8.30	182	0.160	0.040	0.025	0.023

DATE FROM TO	TIME OF DAY	DEPTH FEET	32217 CHLRPHYL A UG/L
72/06/22	16 25	0000	13.2J
72/08/21	08 40	0000	0.7J
72/11/08	15 15	0000	7.4J

J VALUE KNOWN TO BE IN ERROR

STORET RETRIEVAL DATE 75/06/10

551703
43 48 18.0 089 00 42.0
GREEN LAKE
55 WISCONSIN

FEMALES
3

2111202
0100 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3-N TOTAL MG/L	00665 PHOS-TOT MG/L P	00666 PHOS-DIS MG/L P
72/06/22	16 45	0000	17.9	10.6	221	345	8.80	173	0.050	0.020	0.036	0.029
	16 45	0030	17.7	10.8		340	8.70	178	0.040	0.020	0.016	0.010
	16 45	0062	5.6	12.4		350	8.20	179	0.190	0.040	0.050	0.036
72/08/21	09 10	0000			240	370	8.30	169	0.030	0.040	0.011	0.008
	09 10	0004	23.9	8.8		380	8.55	168	0.030	0.040	0.012	0.009
	09 10	0015	23.7	8.8		382	8.60	170	0.030	0.040	0.012	0.009
	09 10	0025	20.4	9.0		390	8.50	174	0.050	0.040	0.012	0.009
	09 10	0040	16.5	8.9		380	8.40	175	0.060	0.040	0.012	0.009
	09 10	0060	6.3	10.5		382	8.80	178	0.260	0.030	0.041	0.039
	09 10	0080	5.0	11.1		390	7.90	178	0.300	0.030	0.053	0.050
	09 10	0100	4.5	10.9		400	7.90	177	0.2 3	0.030	0.053	0.051
	09 10	0125	4.3	10.5		395	7.90	176	0.310	0.030	0.056	0.052
	09 10	0150	4.2	9.5		390	7.80	176	0.360	0.040	0.076	0.071
	09 10	0175	4.1	8.8		400	7.70	176	0.360	0.010K	0.082	0.076
	09 10	0188	4.1	5.4		400	7.73	179	0.390	0.170	0.247	0.204
	09 10	0205	4.1	3.6		395	7.45	182	0.400	0.180	0.249	0.200
72/11/04	14 25	0000			300	415	8.30	169	0.170	0.040	0.028	0.026
	14 25	0004	7.8	11.0		415	8.30	168	0.160	0.050	0.027	0.023
	14 25	0015	7.8	11.0		420	8.30	179	0.150	0.040	0.026	0.024
	14 25	0050	7.8	10.8		420	8.30	180	0.160	0.040	0.028	0.024
	14 25	0075	7.5	10.5		410	8.20	180	0.190	0.040	0.034	0.030
	14 25	0100	6.4	9.7		410	8.00	180	0.240	0.040	0.046	0.043
	14 25	0150	5.1	7.8		410	7.70	183	0.330	0.030	0.083	0.081
	14 25	0175	4.5	7.2		400	7.60	190	0.350	0.030	0.098	0.094
	14 25	0198	4.7	6.9		410	7.50	184	0.370	0.040	0.109	0.107

DATE FROM TO	TIME OF DAY	DEPTH FEET	32217 CHLRPHYL A UG/L
72/06/22	16 45	0000	2.0J
72/08/21	09 10	0000	0.9J
72/11/04	14 25	0000	5.8J

[illegible]

APPENDIX C

TRIBUTARY and WASTEWATER TREATMENT PLANT DATA

STORET RETRIEVAL DATE 75/06/17

5519A1 LS5519A1
43 51 30.0 088 57 00.0
PUCHYAN RIVER
55 15 RIPON
O/GREEN LAKE
ST HWY 49 BRDG NNE OF GREENLAKE
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/09/24	00	35	0.066	0.600	0.084	0.026	0.047
72/10/22	13	30	0.082	1.380	0.357	0.025	0.050
72/11/07	15	15	0.220	0.840	0.100	0.063	0.080
72/12/23	09	33	0.273	0.630	0.080	0.061	0.077
73/01/14	11	05	0.260	0.460	0.054	0.068	0.085
73/02/04	14	02	0.252	0.580	0.046	0.044	0.060
73/03/03	13	35	0.357	0.930	0.160	0.078	0.125
73/04/01	10	35	0.399	0.560	0.040	0.034	0.050
73/04/15	12	58	0.220	0.460	0.012	0.023	0.055
73/05/06	13	00	0.231	1.000	0.011	0.029	0.045
73/05/15	13	20	0.260	0.580	0.028	0.021	0.040
73/06/16	10	15	0.190	1.890	0.120	0.034	0.090
73/07/08	07	25	0.115	1.050	0.154	0.046	0.102
73/08/04	13	30	0.058	1.600	0.440	0.220	0.360

STORET RETRIEVAL DATE 73/06/17

551981 L5551981
43 51 00.0 088 51 00.0
SILVER CREEK
55 13 RIPON
T/GREEN LAKE
CO HWY FF NW EDGE OF RIPON ABOVE STP
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/09/24	11 25		3.470	1.350	0.115	0.132	0.168
72/10/22	13 15		2.700	1.670	1.100	0.115	0.157
72/11/07	14 45		2.800	1.000	0.019	0.015	0.029
72/12/23	09 19		5.300	0.100K	0.060	0.016	0.027
73/01/14	11 20		6.800	0.690	0.036	0.025	0.045
73/02/04	13 50		2.800	1.600	0.270	0.120	0.190
73/03/03	13 15		4.900	1.540	0.230	0.099	0.195
73/04/01	10 24		2.600	0.940	0.032	0.017	0.040
73/04/15	12 45		2.100	0.830	0.011	0.009	0.046
73/05/06	12 45		1.500	1.150	0.012	0.017	0.040
73/05/15	13 00		2.600	0.810	0.021	0.015	0.050
73/06/16	10 05		2.120	2.200	0.160	0.240	0.340
73/07/08	07 00		1.800	1.260	0.058	0.115	0.230
73/08/04	13 00		3.700	1.800	0.160	0.064	0.140

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/06/17

551982 LS551982
43 51 30.0 088 52 30.0
SILVER CREEK
55 15 RIPON
T/GREEN LAKE
ST HWYS 29-49 XING NW OF RIPON BELO STP
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/09/24	08 20		0.800	1.950	0.320	0.176	0.290
72/10/22	13 20			3.600			0.460
72/11/07	14 55		2.300	3.990	0.800	0.310	0.690
72/12/23	09 25		5.200	1.200	0.510	0.168	0.300
73/01/14	11 15		5.900	2.400	0.830	0.081	0.385
73/02/04	13 52		2.900	2.800	0.640	0.154	0.310
73/03/03	13 20		3.700	3.360	0.890	0.180	0.410
73/04/01	10 28		2.500	1.690	0.320	0.060	0.150
73/04/15	12 50		1.920	1.380	0.231	0.056	0.155
73/05/06	12 50		1.640	1.620	0.240	0.063	0.160
73/05/15	13 05		2.800	1.980	0.320	0.115	0.270
73/06/16	10 10		2.000	1.320	0.550	0.265	0.510
73/07/08	07 15		2.040	2.310	0.440	0.240	0.600
73/08/04	13 15		3.300	2.650	0.990	0.210	0.375

STORET RETRIEVAL DATE 73/06/17

551981 LS551981
43 51 00.0 088 51 00.0
SILVER CREEK
55 15 RIPON
T/GREEN LAKE
CO HWY FF NW EDGE OF RIPON ABOVE STP
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/09/24	11 25		3.470	1.350	0.115	0.132	0.168
72/10/22	13 15		2.700	1.670	1.100	0.115	0.157
72/11/07	14 45		2.860	1.000	0.019	0.015	0.029
72/12/23	09 19		5.300	0.100K	0.060	0.016	0.027
73/01/14	11 20		6.800	0.690	0.036	0.025	0.045
73/02/04	13 50		2.800	1.600	0.270	0.120	0.190
73/03/03	13 15		4.900	1.540	0.230	0.099	0.195
73/04/01	10 24		2.600	0.940	0.032	0.017	0.040
73/04/15	12 45		2.100	0.830	0.011	0.009	0.046
73/05/06	12 45		1.500	1.150	0.012	0.017	0.040
73/05/15	13 00		2.600	0.810	0.021	0.015	0.050
73/06/16	10 05		2.120	2.200	0.160	0.240	0.340
73/07/08	07 00		1.800	1.260	0.058	0.115	0.250
73/08/04	13 00		3.700	1.600	0.160	0.064	0.140

K VALUE KNOWN TO BE
LESS THAN INDICATED

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STORET RETRIEVAL DATE 75/06/17

551982 LS551982
43 51 30.0 088 52 30.0
SILVER CREEK
55 15 RIPON
T/GREEN LAKE
ST HWYS 29-49 XING NW OF RIPON BELO STP
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/09/24	08 20		0.800	1.950	0.320	0.176	0.290
72/10/22	13 20			3.600			0.460
72/11/07	14 55		2.300	3.990	0.800	0.310	0.690
72/12/23	09 25		5.200	1.200	0.510	0.168	0.300
73/01/14	11 15		5.900	2.400	0.830	0.081	0.385
73/02/04	13 52		2.900	2.800	0.640	0.154	0.310
73/03/03	13 20		3.700	3.360	0.890	0.180	0.410
73/04/01	10 28		2.500	1.690	0.320	0.060	0.150
73/04/15	12 50		1.920	1.380	0.231	0.056	0.155
73/05/06	12 50		1.640	1.620	0.240	0.063	0.160
73/05/15	13 05		2.800	1.980	0.320	0.115	0.270
73/06/16	10 10		2.000	1.320	0.550	0.265	0.510
73/07/08	07 15		2.040	2.310	0.440	0.240	0.600
73/08/04	13 15		3.300	2.650	0.990	0.210	0.375

STORET RETRIEVAL DATE 75/06/17

551981 LSS51981
43 51 00.0 088 51 00.0
SILVER CREEK
55 15 RIPON
T/GREEN LAKE
CO HWY FF NW EDGE OF RIPON ABOVE STP
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/09/24	11	25	3.470	1.350	0.115	0.132	0.168
72/10/22	13	15	2.700	1.670	1.100	0.115	0.157
72/11/07	14	45	2.860	1.000	0.019	0.015	0.025
72/12/23	09	19	5.300	0.100K	0.060	0.016	0.027
73/01/14	11	20	6.800	0.690	0.036	0.025	0.045
73/02/04	13	50	2.800	1.600	0.270	0.120	0.190
73/03/03	13	15	4.900	1.540	0.230	0.099	0.195
73/04/01	10	24	2.600	0.940	0.032	0.017	0.040
73/04/15	12	45	2.100	0.830	0.011	0.009	0.046
73/05/06	12	45	1.500	1.150	0.012	0.017	0.040
73/05/15	13	00	2.600	0.810	0.021	0.015	0.050
73/06/16	10	05	2.120	2.200	0.160	0.240	0.340
73/07/08	07	00	1.800	1.260	0.058	0.115	0.250
73/08/04	13	00	3.700	1.500	0.160	0.064	0.140

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/06/17

551982 LS551982
43 51 30.0 088 52 30.0
SILVER CREEK
55 15 RIPON
T/GREEN LAKE
ST HWYS 29-49 XING NW OF RIPON BELO STP
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/09/24	08	20	0.800	1.950	0.320	0.176	0.290
72/10/22	13	20		3.600			0.460
72/11/07	14	55	2.300	3.990	0.800	0.310	0.690
72/12/23	09	25	5.200	1.200	0.510	0.168	0.300
73/01/14	11	15	5.900	2.400	0.830	0.081	0.385
73/02/04	13	52	2.900	2.800	0.640	0.154	0.310
73/03/03	13	20	3.700	3.360	0.890	0.180	0.410
73/04/01	10	28	2.500	1.690	0.320	0.060	0.150
73/04/15	12	50	1.920	1.380	0.231	0.056	0.155
73/05/06	12	50	1.640	1.620	0.240	0.063	0.160
73/05/15	13	05	2.800	1.980	0.320	0.115	0.270
73/06/16	10	10	2.000	1.320	0.550	0.265	0.510
73/07/08	07	15	2.040	2.310	0.440	0.240	0.600
73/08/04	13	15	3.300	2.650	0.990	0.210	0.375

STORET RETRIEVAL DATE 73/06/17

55519C2 L55519C2
43 47 00.0 089 01 00.0
SPRING CREEK
55 15 NESHKORO
T/GREEN LAKE
CO HWY K XING E OF GREEN LAKE TERRACE
11EMALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/09/24	09 00		0.680	0.450	0.063	0.015	0.020
72/10/22	13 45		0.580	1.760	0.415	0.044	0.070
72/11/07	15 30		0.690			0.040	
72/12/23	09 50		1.020	1.000	0.052	0.011	0.033
73/02/04	14 17		0.810	0.425	0.026	0.012	0.055
73/03/03	13 50		1.240	2.700	0.425	0.160	0.230
73/04/01	10 51		0.580	0.740	0.031	0.014	0.035
73/04/15	13 01		0.450	0.720	0.012	0.008	0.030
73/05/06	13 05		0.500	0.520	0.016	0.006	0.020
73/05/15	13 30		0.640	0.630	0.032	0.014	0.030
73/06/16	10 30		0.540	2.400	0.060	0.038	0.070
73/07/08	07 45		1.500	0.660	0.030	0.032	0.060
73/08/04	15 10		1.300	2.400	0.056	0.023	0.075

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STORET RETRIEVAL DATE 73/08/17

351951 P0551951 P000500
43 49 00.0 089 02 30.0
AMEN BAPTIST ASSEMBLY
55 15 WISMKARO
DEGREEN LAKE
GREEN LAKE
ILEMALES 2141204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO3+NO2 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P	50051 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
73/01/02	09	00	0.570	19.000	3.500	2.400	2.750	0.031	0.025
73/02/02	11	00							
CP(I)-			0.990	1.350	0.530	1.075	1.300	0.057	0.028
73/02/02	16	00							
73/03/03	08	00							
CP(I)-			1.400	8.400	0.075	2.100	2.900	0.034	0.026
73/03/03	16	00							
73/04/02	08	00							
CP(I)-			1.200	1.700	0.120	1.105	1.500	0.023	0.020
73/04/02	13	00							
73/05/02	08	00							
CP(I)-			1.795	2.300	0.110	2.000	2.600	0.039	0.027
73/05/02	13	00							
73/06/04	08	00							
CP(I)-			0.320	2.100	0.419	3.540	4.000	0.045	0.032
73/06/04	12	00							
73/07/02	08	00							
CP(I)-			12.000	0.490	0.190	4.700	5.100	0.040	0.045
73/07/02	12	00							
73/08/02	08	00							
CP(I)-			0.852	0.480	0.050	8.700	11.750	0.047	0.052
73/08/02	12	00							
73/09/04	08	00							
CP(I)-				1.500		0.130	0.800	0.040	0.060
73/09/04	12	00							
73/10/02	08	00							
CP(I)-			7.000	2.400	0.175	5.600	5.200	0.036	0.049
73/10/02	12	00							
73/11/02	08	00							
CP(I)-			8.100	12.000	1.325	3.300	4.100	0.046	0.045
73/11/02	12	00							
73/12/03	08	00							
CP(I)-			1.700	1.500	0.340	2.100	7.000	0.026	0.032
73/12/03	12	00							
74/01/02	08	00							
CP(I)-			2.000	4.400	0.490	1.200	2.100	0.006	0.027
74/01/02	12	00							

A VALUE KNOWN TO BE
LESS THAN INDICATED